Mineral Help

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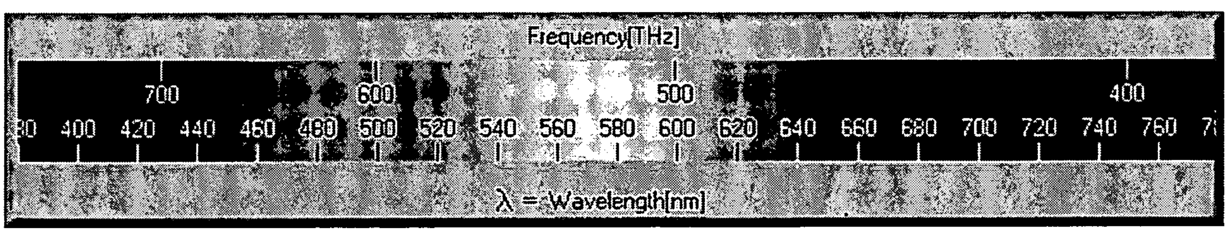
Reflectivity in Minerals

See Also: Color, Pleochroism, Bireflectance, and Anisotrophism.

Reflected light microscopy is used to examine opaque minerals (and other materials, e.g.. ceramics) to determine the paragenetic relationships between different mineral phases and their identification. Often, the same specimen which is viewed using the light microscope can be analyzed using advanced x-ray and ion microprobe techniques.



The process to measure reflected light is very simple. The sample (polished thin section, epoxy grain mount, or polished section) is placed in the appropriate reflected light microscope. The reflectivity is measured by observing the incident and reflected light at different wavelengths. The reflective index is the percentage of light that bounces off the solid surface and is not absorbed. The apparatus is calibrated using reflective standards such as silicon carbide (SiC) or other materials with a known response.

Method to Display **RGB** Values

Reflectance measurements for opaque minerals consists of a table of wavelength values versus % reflectivity at that wavelength. The measurements are generally made in air but oil is sometimes used for high magnifications. In addition, reflectance values for pleochroic materials are listed as $\mathbf{R}_1$ and $\mathbf{R}_2$ values. These values are calibrated to known standards and represent the "**standardized intensity**" of that mineral.

To regenerate the original macroscopic color from reflectance measurements, the red, green and blue (**RGB**) values for each mineral are added from the spectral data, normalized, and recalculated as $\sum \mathbf{R}(\lambda)$.

Wavelength vs RGB Values

Wave Length	Red	Green	Blue	Color.BMP	Wave Length	Red	Green	Blue	Color.BMP
400	131	0	181		560	195	255	0	
410	126	0	219		570	225	255	0	
420	106	0	255		580	255	255	0	
430	61	0	255		590	255	223	0	
440	0	0	255		600	255	190	0	
450	0	70	255		610	255	155	0	
460	0	123	255		620	255	119	0	
470	0	169	255		630	255	79	0	
480	0	213	255		640	255	33	0	
490	0	255	255		650	255	0	0	
500	0	255	135		660	255	0	0	
510	0	255	0		670	255	0	0	
520	54	255	0		680	255	0	0	
530	94	255	0		690	255	0	0	
540	129	255	0		700	255	0	0	
550	163	255	0						

RGB measurements are based on the the component colors for pure red (255,0,0), green (0,255,0), and blue (0,0,255). In this system, black is (0,0,0) and white is (255,255,255). There are 16,581,375 colors based on the RGB nomenclature. Since RGB color is based on human perception, there is no "correct" value of RGB to wavelength.

Because the color response of computer monitors is also a variable, the colors represented from these examples is only approximate.

Calculated Relative Intensity Colors

The calculated relative intensity colors are approximated by taking the reflection measurements of the "standardized intensity" values and multiplying by a percentage from 0% to 1,000%. These values are then normalized, and recalculated as $\sum \mathbf{R}(\lambda)$ as a function of relative intensities based on the 0 to 10 values (0 to 1,000%). The range of colors are selected to span all values of **RGB** from (0,0,0) to (255,255,255). The representative ranges for each

species are selected by picking those ranges to display a reasonable color spectrum. The following examples represent a selection of colors calculated for common opaque minerals:

Calculated Relative Intensity Colors of Anatase in Air

Relative Intensity	0%	50%	**100%**	150%	200%	250%	300%	350%	400%	450%	470%
R_1											
R_2											

Calculated Relative Intensity Colors of Bornite in Air

Relative Intensity	0%	50%	**100%**	150%	200%	250%	300%	350%	400%	450%	490%
R											

Calculated Relative Intensity Colors of Enargite in Air

Relative Intensity	0%	40%	80%	**100%**	120%	160%	200%	240%	280%	320%	350%
R_1											
R_2											

Notice the extreme pleochroism in graphite.

Calculated Relative Intensity Colors of Graphite in Air

Relative Intensity	0%	**100%**	200%	300%	400%	500%	600%	700%	800%	900%	1000%
R_1											
R_2											

Calculated Relative Intensity Colors of Millerite in Air

Relative Intensity	0%	30%	60%	90%	**100%**	120%	150%	180%	210%	230%
R_1										
R_2										

Calculated Relative Intensity Colors of Pyrite in Air

Relative Intensity	0%	30%	60%	90%	**100%**	120%	150%	180%	200%
R									

Calculated Relative Intensity Colors of Silver in Air

Relative Intensity	0%	20%	40%	60%	80%	**100%**	120%
R							

In all cases, the color represented in these tables approximates the **pleochroic** color (**R_1** & **R_2**) or color (**R**) viewed in a polished section of that mineral under plane polarized light. The relative intensities in the tables show how much illumination is required to see the colors from each species.

Click here to view a table of all the opaque-mineral reflected-light calculated colors.

Other References to Reflectivity and "Color"

An Atlas of Opaque and Ore Minerals and their Associations from the SME

Reflected-light Microscopy from the University of Utah.

Data from the "Visible Light Spectrum" program from efg's Computer Lab was used to obtain the spectral colors used in the calculation of the macroscopic color based on reflectance measurments.

Dan Bruton's COLOR SCIENCE web page.

Search the Mineralogy Database

Match All term in the Database: [All]

reflectivity Search

Example Subject Searches

Example: "reflectivity" finds all minerals that have reflected light spectral data.
Example: "short uv-yellow*" finds all minerals that are fluorescent yellow in the short ultra violet.

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